The Big Cottonwood Power Transmission

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The Big Cottonwood Power Transmission

Before proceeding to a description of the recently completed electric transmission of the Big Cottonwood Power Company it is well to briefly review the natural advantages of the country contiguous to Salt Lake City in order that an accurate idea of the importance and far-reaching effect of the enterprise may be appreciated. It has been pointed out in an article by Mr. Geo. Heli Guy, in the Electrical Engineer, that cheap electric power for Salt Lake City and vicinity will open up unequalled opportunities for various electrical enterprises not only in the delivery of power for the operation of existing installations, but also for electro-chemical work. The district has bauxite in abundance, and in this industry power is all-important, and freight is hardly considered. For the manufacture of salt products, bleaching powder, disinfectants, soda, sodium, calcium carbide, etc., all the raw materials are on the ground, and cheap power only is needed. The electro-deposition of copper will certainly grow into a huge industry, for the extensive leads of copper ores are as yet undeveloped. A large copper smelting plant has recently been placed in operation. The electro-deposition of gold and silver is also a coming industry which will rapidly expand when cheap current increases the economy of the process. These are classes of work depending for their successful prosecution almost entirely on power, and requiring materials mined or found in the Salt Lake country in enormous abundance. In mills and factories the ordinary industrial operations likely to be created by cheap power are wool scouring, paper making, the manufacture of cotton fabrics and the making of flour. With the increase in these factories there will be a call

RESERVOIR OF THE BIG COTTONWOOD POWER COMPANY

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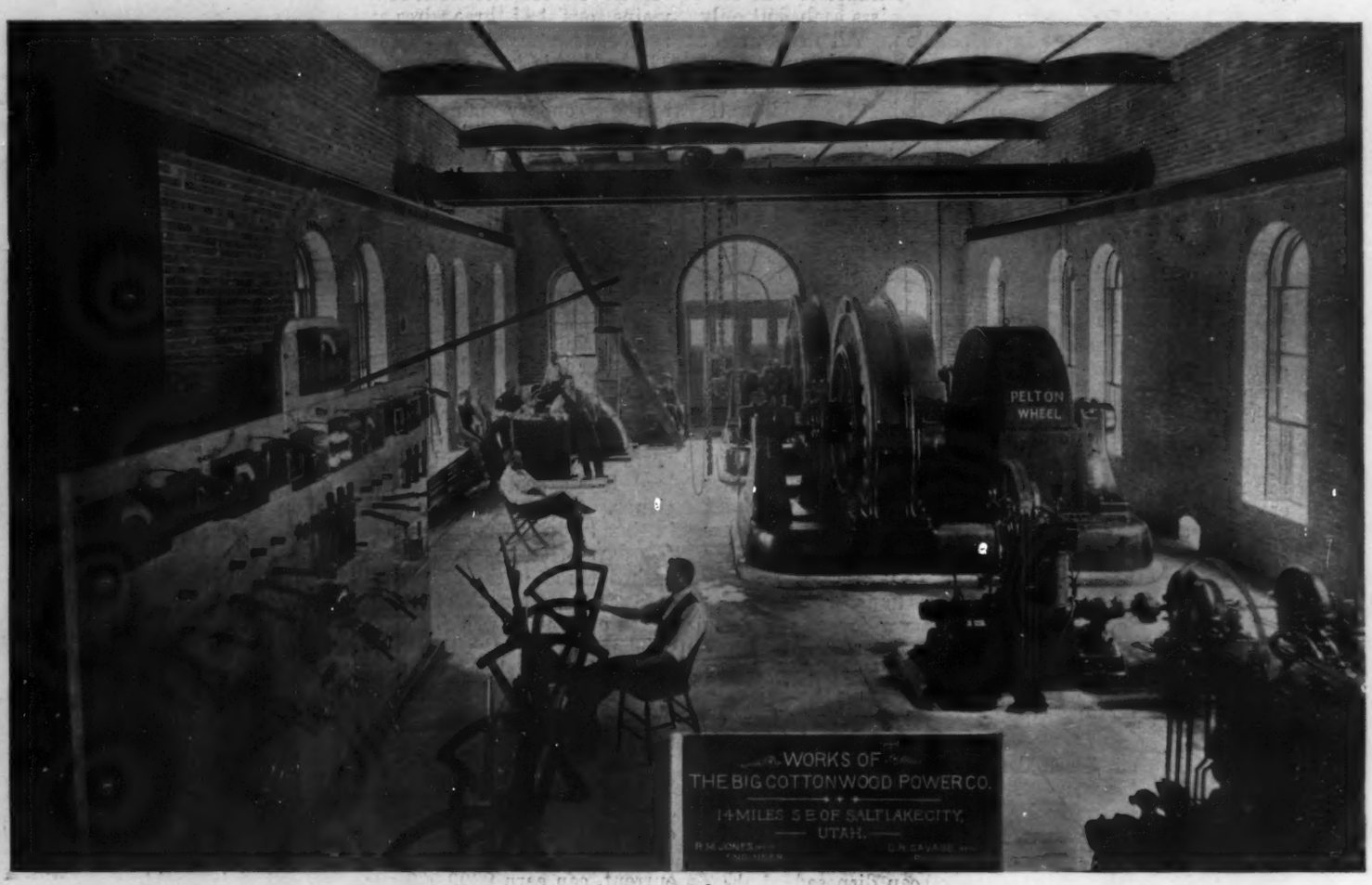
for better facilities for iron workers and engineering work, which will require further power. There will be a prompt and large demand for current for electric transit. Cheap power will enable trolley lines to be pushed out all over the Salt Lake Valley to be used for bringing farm produce into the city and ores to the smelters. With these improved facilities for transportation, the farming industry of the Salt Lake Valley will increase enormously, and a large fruit trade will be established. Three electric roads are already operating successfully; the Salt Lake City Railroad Company, the Salt Lake Rapid Transit Company and the West Side Rapid Transit Company, operating in the aggregate upward of 100 miles of track and about 100 cars. These roads already stretch out from 5 to 10 miles from the centre of the city. The output of gold and silver ore with lead bases is infinitely larger than statistics show, owing to the fact that enormous quantities of ore are shipped to Colorado smelters. Before long these ores will be smelted in Utah by electrical processes. The headquarters of the large mines, such as the Ontario, Centennial, Eureka, Mammoth, Anchor, Crescent, Silver King and the various mines in Park City, Tieutic, Bingham and Mercur, are all located in Salt Lake City. The first successful practical application of the cyanide process for extracting gold ores was made at the Mercur mines located within 10 miles of the city. There are four large smelters and five sampling works. These smelters and the mines require large quantities of power continuously through the year, and though the application of electricity to mining is somewhat slow, it will surely become general. The Ontario mine has taken the lead by putting in a small monocyclic light and power plant, utilizing the water from the great drain tunnel.

The Big Cottonwood river forms the drainage of the Wahsatch range of the Rocky Mountains, lying immediately back of Salt Lake City, and the lakes entering into the Big Cottonwood canyon, lie at altitudes of from 11,000 to 13,000 feet above the sea, so that difference of level is considerable even when the water is made to give up its energy at a point some thirteen miles southeast of Salt Lake City. As a matter of fact, the company has available over 1,000 feet of fall in various spots, but at present is using less than 400. The power station, illustrated on page 22, is situated in the canyon at "The Stairs," about 14 miles by pole line from the distributing of "step-down" station of the Salt Lake and Ogden Gas and Electric Light Company, in Salt Lake City. At this point there is a minimum flow of 3,400 cubic feet per minute, which, working under 380 feet head, produces 2,447 horse power any and every hour in the year. During nine months of each year, it will give nearly 4,000 horse power. The frontispiece illustrates the

POWER HOUSE OF THE BIG COTTONWOOD POWER COMPANY

storage reservoir at the head of "The Stairs," which has an available capacity of 24 hours' continuous flow of the stream, making all of the water available by using an excess during maximum loads and allowing the reservoir to accumulate during minimum loads. 58,800 horse power per day of 24 hours, is looked for from this source, of which 68 per cent. can be delivered in Salt Lake City in contract form, making 40,000 horse power hours net daily. The 68 per cent. efficiency is derived from: Pelton water wheels 80 per cent., General Electric Company generators 94 per cent., G. E. transformers (raising) 97½ per cent., line transmission 95 per cent., G. E. transformers (reducing) 97½ per cent., or a total of 68½ per cent. The map of the reservoir shows a pipe line extending from the head gates, submerged in the bottom of the reservoir, to a penstock or receiver wood housing with "grizzlies" located just below the bridge. This pipe, of steel-banded redwood, is anchored to the bottom by rock piles, and is to be used in the event of its being necessary to drain the reservoir, without interfering with the running of the station. This is accomplished by closing the headgate valves, and the station can thus be supplied from the natural flow of the stream, during such time as the reservoir might be empty. The steel pipe line was built by the Frazer & Chalmers Company of Chicago.

The outside dimensions of the generating station are 34 feet by 100 feet. The generating plant, a view of one half of which is shown on page 23, consists of four 450 kilowatt three-phase 60-cycle General Electric generators, separately excited, non-compounded, set with armatures parallel to each other, facing up in true line in the building. Each generator is driven directly by one heavy special Pelton wheel, 60 inches in diameter, provided with two nozzles of 3¼ in. diameter. The nozzles are provided with hood valves for shutting off, so that both good regulation and economical use of water are secured. Each nozzle at 370 feet effective head, produces 310 mechanical horse power, and drives the wheel at 300 revolutions per minute, its economical speed. The water wheel is keyed directly on the armature shaft, and in addition to the generators named, four 12½ kilowatt exciters are connected together in pairs by couplings, each set being driven by a 14-inch Pelton wheel, with cast housings. Each set consists of two generators and two wheels, built up on a cast-iron base-plate, making a rigid and direct connection. This application provides exciting energy in two units, and at all times either one or two exciters are in reserve. The exciters are to be run in multiple, and all connected to one common "bus line" on the switchboard. The three-phase generators are also operated



INTERIOR OF THE BIG COTTONWOOD POWER HOUSE

in parallel. There are six raising transformers, 265 kilowatts each, of General Electric make.

The station switchboard consists of 5 panels with complete controlling and indicating apparatus, and there is a 3-panel raising transformer switchboard. At the step-down or distributing station, there is a 3-panel reducing switchboard, with proper regulating apparatus. The apparatus is protected by ball lighting arresters, and the transformers are cooled by two Sturtevant exhaust fans driven by two 5-horse power induction motors.

The 915 poles for the line construction were selected from live growth of Sand Point (Idaho) cedar. The smallest are 40 feet long, and 8 inches in diameter at the top. They are placed 100 feet apart. The line conductors will consist of 12 wires, four circuits of three wires each, but only three such circuits are now in position. All wires are of No. 2, soft-drawn bare copper, and connected to the same common "bus line," at the generating and at the distributing station. The line loss, in delivering 1,520 kilowatts at 10,000 volts, is something less than 5 per cent.

The transmission line from generating to distributing station is 14 miles by pole line. The distributing station is owned by the Salt Lake and Ogden Gas and Electric Light Co., who rent it to the Big Cottonwood Power Company at a nominal rent. It contains, for "step-down" transformation, nine 160 kilowatt air blast transformers, from the secondary side of which the Electric Light Company buys the current wholesale by meter. This arrangement is a most convenient one for both companies. The actual terms of the contract are that the electric light company is to be supplied with all the current it can dispose of for electric lighting and power, in units of 10 horse power, and under, the Big Cottonwood Company reserving the right to supply power to motors in units exceeding 10 horse power, and the right to reach such wholesale users of power by wires erected on the electric light company's poles, throughout all the districts within the city limits. The contract dates from January 1, 1896, and runs for a term of five years. Its conditions are that the current is bought at 2,000 volts, 3-phase, at a stipulated price per k. w. hour, which will be used to supply electric light and power for any purpose up to 10 horse power, and for elevator service up to any limit desired by the lessees. 2,000,000 units annually is the minimum limit of the consumption of current.

The final cost of the complete development is estimated at $300,000. An estimate of $300,000 for the original outlay for "The Stairs" would give for construction expenses —at 2,258 horse-power—$132.72 per net horse-power delivered in the city ready for use. The future of the company seems to be well assured. The company's affairs have been so well administered that much more than half the power to be developed has already been disposed of absolutely, and the guaranteed total revenue from completed contracts is over $100,000 annually. Although the company is confining its operations for the present to "The Stairs" supply, it has, as already stated, other valuable water rights partly developed by means of which it could at any time largely supplement its output.

In order to secure the best results from the three-phase current the Salt Lake Gas and Electric Company, originally a single-phase plant, has modified its distribution system. The new system consists of a network of primary mains with a network of low tension secondaries, wherever the houses are in close proximity to each other. The primary mains are at 2,000 volts. They run along every street east and west and have equalizing cross mains on several streets running north and south. There will eventually be ten feeding points, though at first only six are required. Secondary mains are used almost entirely; only when the houses are very scattered separate house transformers are used. In the commercial district, the secondary and primary mains will eventually be put underground, though this is not immediately contemplated. The transformers are placed at street intersections in banks either fixed on poles or in any suitable location near the intersection. In the commercial districts there will be a bank of transformers at every street intersection; but in the incidental districts one bank will be placed at every other intersection, the blocks being 792 feet square. The feeders are brought from the distributing station situated near the center of the town. The current is supplied from the generators of the Big Cottonwood Power Company's station on the three-phase system. The feeders and primary mains therefore consist of three wires each of the same size. The secondary mains consist of three wires and a neutral wire. The voltage between any one of the three wires and the neutral is 115, and this is the voltage of the lamps. Motors, synchronous or non-synchronous, can be connected at any point to the secondary mains, or, when the motor is large, separate transformers will be used. It is intended to eventually use the alternating current for all arc lamps, in which case they will be connected to the secondary mains with small transformers. At present the arc lighting of the city is done by constant current generators driven by three-phase synchronous motors in the old steam power house of the Salt Lake Gas and Electric Company.

The distributing station is a substantial fire proof building, with a room for the 10,000-volt step-down transformers, the 2,000-volt switchboard and fitted up with instruments for testing and calibrating meters, etc.

The distributing system and feeders have been designed of ample capacity for a small drop, and with the complete system of primary and secondary mains the regulation is perfect. By cutting out transformers during times of light load, it is expected to obtain a very high distribution efficiency. The Stairs plant of the company was completed in time to deliver current in Salt Lake City by June 1. A few days after, the greatest flood seen in thirty-five years rushed through the canyon, thus testing in the severest manner the strength of the construction. Not a dollar's worth of damage was done.

The officers of the Big Cottonwood Power Company are John W. Donnellan, president (cashier Commercial National Bank, Salt Lake); W. H. Rowe, vice-president, (president Bear River Canal Company); Geo. M. Cannon, secretary (cashiers, Zion's Savings Bank, Salt Lake); G. M. Downey, treasurer (president Commercial National Bank, Salt Lake); R. M. Jones, engineer and manager, Salt Lake; Jos. W. Summerhays, director, Salt Lake. The Old Colony Trust Company, of Boston, is its trustee.

At the present time, The Stairs plant, at ruling rates for current, can earn $200,000 per annum, and it would seem that a ready market exists for light and power now, some 27 concerns using over 2,000 horse-power. Many of these establishments work every day the entire year, and their steam power has cost them from $90 to $145 per horse-power per year.

These works have involved an outlay of something over $300,000, all of which has been furnished by local capitalists. The company states that contracts for power have already been made, which afford a revenue of $100,000 per year with a very considerable surplus of power yet to be disposed of, which insures a dividend of not less than 20 per cent. per annum over and above interest and operating expenses.

The financial as well as engineering success that has attended most enterprises of this character in various parts of the country, has given assurance of safe and profitable returns to all such investments where planned with proper reference to cost of installation and commercial value of power produced.

Telegraphy

IMPROVEMENT IN DYNAMO-TELEGRAPHY.

BY F. P. MEDINA.

The substitution of dynamo generators for chemical batteries in Telegraphy, while on the whole a great improvement, was attended by impairment of the efficiency of quadruplex systems. It augmented very considerably a cause of vagueness in signaling that the researches of many experimenters had gradually minimized. It involved the return to a method of signaling with double currents, that existed before Edison introduced his continuity-preserving pole-changer, and lost to the dynamo-quad some of the fruits of the great inventor's best work on the chemical-quad.

In spite of these facts, the superiority of the dynamo as a generator induced the Pacific Postal Telegraph Company to install a plant in its San Francisco office. Mr. L. W. Storror, the superintendent of the company, would not permit the existence of one defect in a single piece of apparatus to stand in the way of the adoption of an improvement so great in every other particular; and especially as he did not believe the defect was irreparable. Besides, the dynamo-quad had been worked in the East, and if it could be worked in one place it certainly could be worked in another. He therefore directed its adoption and in 1894 San Francisco office was equipped with the new generators.

Two direct current transformers were used, one to give E. M. F. of position sign, the other of negative. They transformed from 110 volts to 400, and were manufactured by The Electrical Engineering Company of San Francisco. The character of the motor generator combination used is clearly shown in the accompanying illustration and the distinctive feature of the dynamo appearing at the left in Figure 1 is the large diameter of its commutator and the arrangement of the eight brushes which are placed equidistant on the surface of the commutator, thus affording different potentials from which have been operated successfully for the past four years, telegraph circuits of various lengths from a few hundred yards to 1,200 miles. In this respect he dynamo telegraph plant of the Pacific Postal Company differs from similar installations in the East, where a separate machine is used for each potential.

The quads worked very inefficiently and the technical department felt obliged to continue the use of the chemical batteries on them. Reports of the dynamo-quads in the East were conflicting, and not on the whole very encouraging. Mr. Storror promoted experiment, however, and it is chiefly due to his persistence and never-failing confidence as to ultimate success, that the dynamo quadruplex is now being worked by the Pacific Postal Company with even greater efficiency than was attained with chemical batteries. The improvement has been accomplished by a device, the nature of which will be better understood after comparing the dynamo-quad with its chemical progenitor.

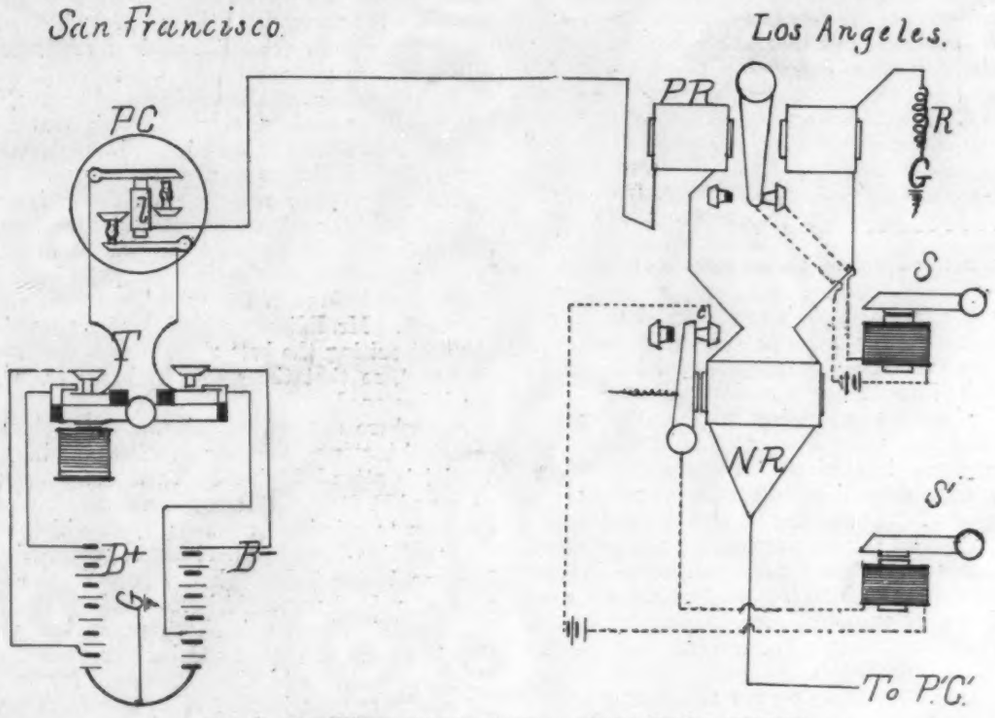


FIG. 2—SIMPLIFIED DIAGRAM OF A QUADRUPLEX CIRCUIT.

On long circuits the cause of vagueness in signaling becomes, even in chemical quads, exceedingly marked and annoying. It will be readily understood by reference to Figure 2, which is a diagram of a quadruplex circuit, omitting at one end (to simplify matters) the transmitting apparatus, and at the other end, the receiving instruments. Of the transmitting instruments in San Francisco, P. C. is a pole-changer that sends signals into the polarized relay P. R. in Los Angeles by reversing the currents to the line. It does this by putting the line in contact with the batteries B plus and B minus respectively, by the movements of a lever 1, shown in vertical section, to which the line is attached. The lever is moved by an electro-magnet in a local circuit controlled by the key of the transmitting operator. The current strength used in operating the relay P. R. by the reversals of P. C. is small—about 20 milliamperes usually, and does not affect the relay N. R. because the retractile spring on the lever of the latter instrument is adjusted to resist the pull of its magnets. The windings on N. R. are fewer than on P. R. and the whole force of the transmitting battery, giving about 60 milliamperes, is needed

to operate the relay N. R. It will be noted that P. R. is worked by reversals of current and N. R. by variations in current strength. The transmitter T produces these variations by adding or subtracting cells from the batteries B plus and B minus, so that the transmitter T operates the relay N. R. and the pole-changer P. C. operates the relay P. R.

Now, it is in relay N. R. that the cause of vagueness in

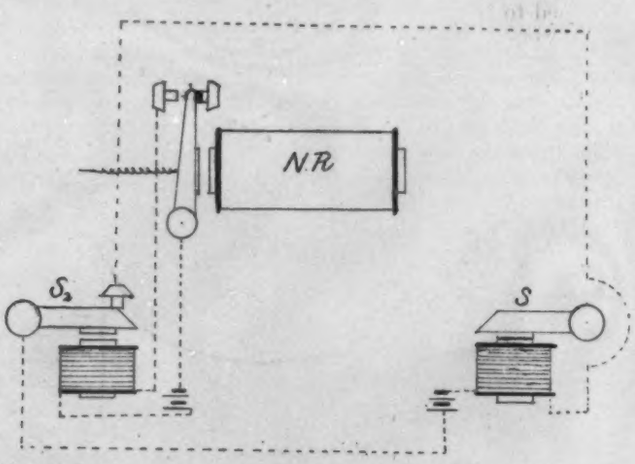


FIG. 3—EDISON'S DEVICE FOR REDUCING THE REVERSAL INTERVAL.

signaling shows its effects. This is the instrument that is affected; and by tracing the series of operations that take place when transmitter T. is sending a signal into N. R. the character of the interference is readily discerned. Let transmitter T. for instance be sending out the full current, closing the contact of relay N. R. at C, and closing the sounder S, through the local circuit controlled by the relay lever. Now, suppose at this instant the operator using P. C. sends a reversal into the line in signaling to P. R. The batteries B plus and B minus are short circuited for a moment through the lever 1, and then exchanged one for the other, the current on the line falls in strength and rises again to a maximum of opposite sign. The time that it takes to do this is proportional to the resistance of the circuit and to its static capacity.

The time required for a complete reversal from a maximum current of one sign to a maximum current of the opposite sign at the distant station is called the reversal interval, and this reversal interval is the cause of obscurity in signaling to N. R.; for it is plain that if the interval is not so short that the spring on the lever of N. R. has not time to act, a false signal must be caused in S by a momentary break at the contact points c, at every reversal of P. C. In practice the interval is never so short as this; and it was not until Thomas A. Edison had applied his device for neutralizing its effects, that the quadruplex could be worked.

Figure 3 shows the device of Mr. Edison, in which it will be seen that N. R. closes the local circuit on its back contact c, and that this local circuit, instead of operating the receiving sounder S directly, does it through a repeating sounder S. 2. This repeating sounder operates the local circuit through S. Now, observe the effect of this simple contrivance in obviating the disturbing effects of the reversal interval. Suppose once more, that T. Figure 2 is closed, closing N. R. Contact is broken at c, opening sounder S. 2, which closes the local circuit of sounder S. Now, when P. C. reverses the lever of N. R. is pulled back by its spring as at first; but before it can make a false signal on S, it must close sounder S. 2, the self-induction of which is thus used to offset the reversal interval on the main circuit. The relay lever is thus re-attracted by the reversed current before its falling off has caused a false signal in S.

This device works well, provided the circuit is not so long that the combined static capacity and resistance make the reversal interval too great. Circuits longer than two or three hundred miles demand something in addition to the Edison device. F. W. Jones, Gerritt Smith and others have added devices to act on the relay armature itself, either directly by an auxiliary magnet and separate inductive circuit, as is done by Mr. Jones, or through auxiliary windings on the relay core, as is done by Mr. Smith, or directly through the main line coils, as by the writer. They all act by applying a momentary force to the relay either to hold the lever for an instant while the line is reversing, as by Mr. Jones, or by causing the relay cores to reverse very quickly, as by Mr. Smith and the writer.

It is readily seen, therefore, that the reversal interval is a serious matter in quadruplex telegraphy, and that anything that will shorten it is an improvement. The continuity preserving pole-changer of Mr. Edison P. C., Figure 2, applies the reversals to the transmitting end in the ideal way. Since the reversal interval is proportional to the static capacity and resistance of the circuit, whatever tends to reduce either quantity reduces of course, the interval. The primitive mode of signaling with double currents was by a front and back contact key, Figure 4, during every reversal of which the main current was opened. In the quadruplex this mode would increase the resistance factor of the reversal interval, not to infinity at the transmitting station as it might seem, but to the amount of the resistance in the compensating circuit shown in Figure 2 at the Los Angeles end through the relays and resistance box R. to the earth. Mr. Edison avoided this increase of resistance by short circuiting the batteries through the lever 1 of P. C., Figure 2, so that the static discharge from the line was much hastened.

But where dynamo machines are substituted for the chemical batteries in Figure 2, short circuiting through the level 1 is attended with destructive arcing at the contact points of P. C. There appeared to be no help for it but a return to primitive methods, from which was developed the "walking-beam" pole-changer, such as is used by the Western Union Telegraph Company in the East, and the type of pole-changers hitherto applied to dynamo-quads. These walking-beam pole-changers are clearly nothing more than the primitive front and back contact keys of the pre-Edison age, shown in Figure 4, except for being worked by an electro-magnet instead of by hand. They possess the bad feature of lengthening the reversal interval.

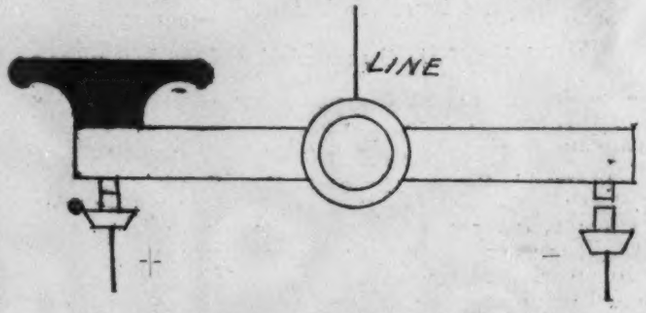


FIG. 4—THE PRIMITIVE "WALKING BEAM" POLE CHANGER.

This was the experience of the Pacific Postal Company that compelled the postponement of the application of the dynamo plant to its quads. Many different types of pole-changers were tried, and many contrivances employed to put the dynamo-quad on an equal footing with the chemical.

Some of the facts brought out by these experiments, although not particularly new, are still strikingly interesting. For instance, two quadruplex sets were joined together through a resistance coil adjusted to equal the Los Angeles

circuit in resistance. It was found that the breaking space separating the contacts of the pole-changer had to be increased beyond that which was necessary when a pole line was used, else an arc was likely to form at the pole-changer contacts. This arc started as a true self-induction spark. When a pole line was used, however, the contacts could be worked much closer, and the spark was formed on making

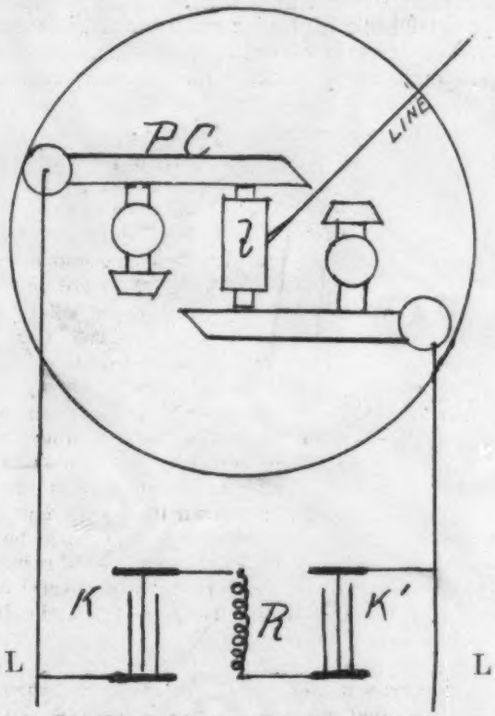


FIG. 5—THE MEDINA MODE OF SOLVING A QUAD PROBLEM IN DYNAMO-TELEGRAPHY.

contact, not on breaking it. In other words, the static capacity of the line neutralized the tendency of the dynamos to arc across the contacts, and added a little energy of its own. The theory of its action would seem to be somewhat as follows, as far as neutralizing the self-induction spark is concerned:

The dynamo charges the line to a certain potential, and the amount of this charge is proportional to the static capacity. Now, if the charge is great enough the contact point on the lever will retain, for an instant after break, something near the same potential as the contact point from which it has just parted, so that the potential difference between the two will be too small to create an arc. If it is admitted that a certain potential difference is required to maintain an arc across this air space, and the static charge of the circuit tends to prevent this potential difference, then when such an arc occurs with walking-beam pole-changers, and it does sometimes occur, it must be due to some fluctuation of the static charge that permits this potential difference to be formed. A cause of this fluctuation may be found in the bright spark at the opposite pair of contact points which occurs just before making contact. It is the static discharge from the line, and obviously if the line is discharged there is nothing to prevent the full potential difference from forming between the parting contact points, perhaps at the very moment of parting. This, I think, is the way the arc at the pole-changer contacts is formed, and not principally by the static discharge as has been held.

Corroborative evidence is furnished by the behavior of a continuity-preserving pole-changer as in Figure 2, on a circuit containing excessive capacity. The Pacific Postal Company work a circuit from San Francisco to Albuquerque —1200 miles long, the capacity of which is about double that of ordinary five or six hundred mile circuits. Now, it was found that continuity-preserving pole-changers could be used on this circuit with dynamos, if the pole-changers were finely adjusted so that the static charge could not escape before contact was broken. The discharging line seemed to momentarily stop the current in the lead to the contact point that the lever parts from, by establishing a potential equal to that of the dynamo. At least there seemed to be no current broken at the contacts. But this condition is obviously an unstable one, liable to be changed by a slight variation in the static capacity or in the time of contact. Experience showed this to be true, and the pole-changers could not be depended on not to arc.

It became more and more evident that the true solution of the quad problem lay in the application of a continuity-preserving pole-changer. The facts detailed above seemed to point out a means of applying it. If the application of a static charge could be made at the proper moment in such a way that the potential difference between the breaking points must always be small, no arc could form.

Figure 5 shows the plan devised by the writer to produce this effect, and the Honorable Commissioner of Patents of the United States has been good enough to pronounce it his invention. P. C. is a continuity pole-changer, L. L. leads to the positive and negative dynamos respectively. K. K. are very small condensers, having capacity of about twelve one-hundredths of one microfarad each, and R. is a small resistance to diminish the current of discharge from condensers K. K. when P. C. is reversing. Now, these condensers act like a variable resistance, in a well-known way, and keep the potential difference of all the contact points very small until the parting points are widely separated, thus destroying all tendency to arc. The static spark that occurs just before contact is made, is, with this device, no longer a source of arc production, and, as it hastens the discharge of the line, becomes now a desirable feature.

The stations at the end of the quad circuits report enthusiastically in favor of the new arrangement, declaring that the reversal interval is smaller than with chemical batteries. It may be that the static spark as indicated above has something to do with quickening the reversals; but at any rate it is a conservative way of putting it to say that the dynamo quad of The Pacific Postal Company is fully equal in efficiency to the best chemical quads.

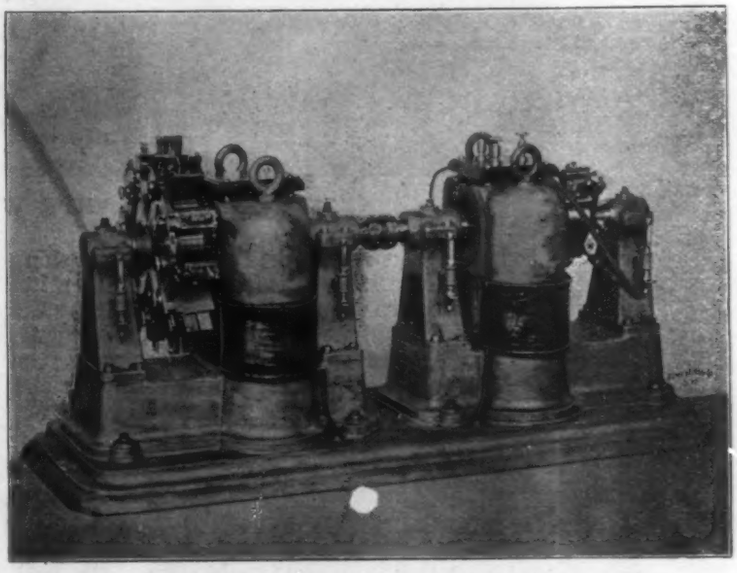


FIG. 1—MOTOR-GENERATOR OUTFIT OF THE ELECTRICAL ENGINEERING COMPANY, AS USED IN DYNAMO-TELEGRAPHY.

Hydraulics

WATER WHEEL REGULATION

The Tuolumne County Electric Power and Light Co. has recently installed a 3-phase transmission plant in Sonora, Cal., which contains several interesting features not found elsewhere. The apparatus used is of the General Electric tri-phase type, and in addition to lighting the towns of Sonora and Columbia, the company is furnishing power to the Rawhide mine. It is in this mine that a 150 h. p. induction motor has been installed for operating the main hoist. The speed of the motor is controlled by means of a special regulator resembling in outward appearance the latest type of General Electric street railway controller, and consisting of commutating devices by means of which the direction of the motor is controlled and of suitable contacts for cutting equal resistances simultaneously into the three leads of the motor.

The generating station is operated by a 48-inch Pelton water wheel running under a head of over 900 feet and as the key-note of success in the operation of this plant rested in securing the very close regulation of the water wheels, it was determined to depart from the usual types of water wheel governors to satisfy the demands. Accordingly, Mr. J. A. Lighthipe, Chief Engineer of the Pacific Coast office of the General Electric Co., designed the electric governor illustrated herewith, to meet the exigencies of the case. This governor, which is the first one built, has now been in operation for several months with such success that steps are being taken for its installation in other plants where trouble is being experienced in the governing of water wheels operating under high head.

In principle, the Lighthipe governor consists essentially of a series motor with a double wound field; that is, a field containing two independent windings, each connected in series with the armature in such a way that while the direction flow in the armature is always one way, the polarity of the field is changed according to which of the two field windings is used. To the armature shaft is direct connected a screw carrying a traveling nut which moves backward or forward according to the direction of armature rotation, and by the nut is operated a rod which in turn controls a crank operating the hood or other means of regulating the water supply. From the main shaft of the water wheel is driven a centrifugal governor by belting and this governor actuates the motor circuit through one or the other of the field windings.

The troubles heretofore experienced in the governing of water wheels have been due to the slowness of the pawl method of actuation and to the fact that "see-sawing" is

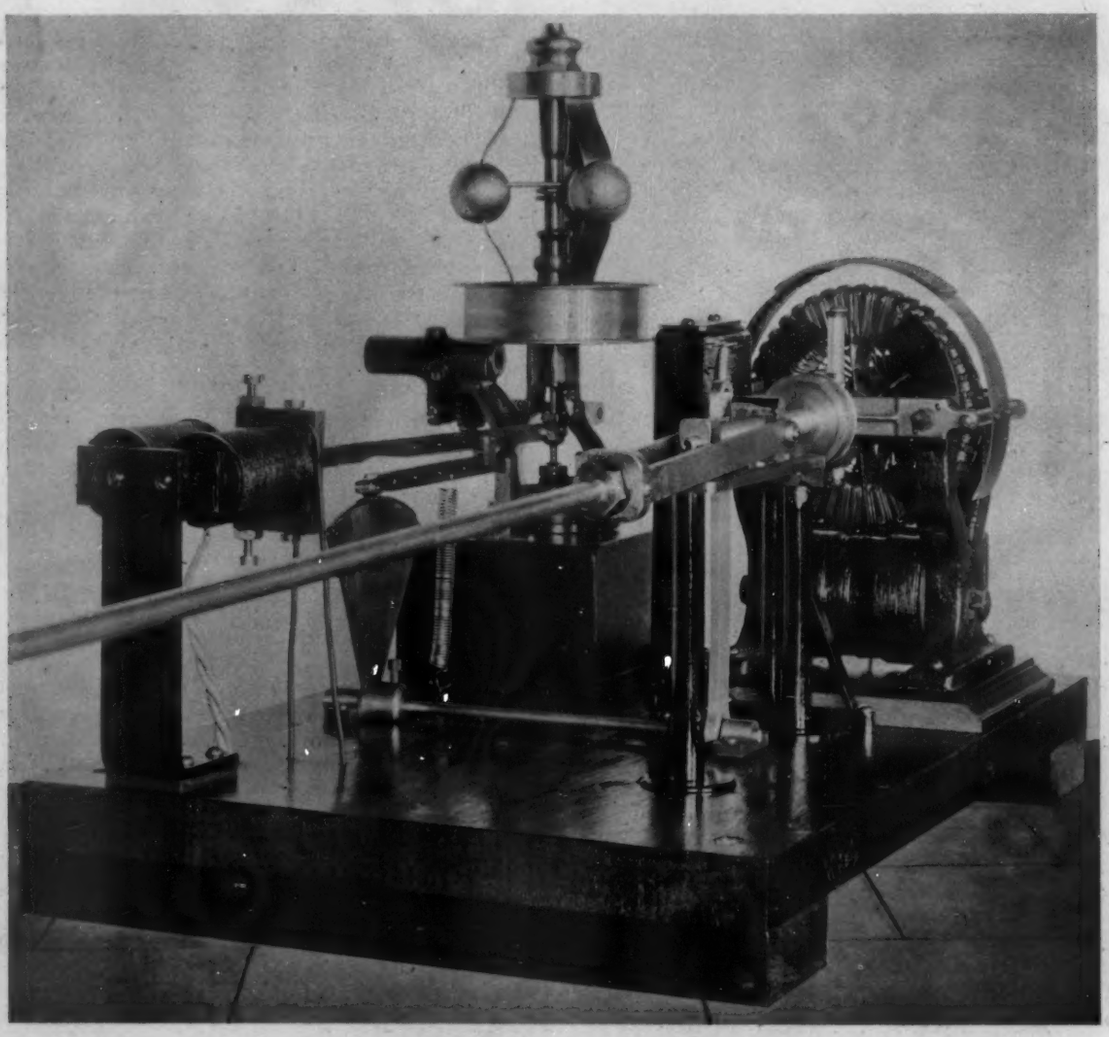


FIG. 1—THE LIGHTHIPE WATER WHEEL GOVERNOR

caused by the action of the governor in continuing to deflect the nozzle, to a greater extent than that necessary to reduce the power of the wheel to the desired point. The nozzle, therefore, goes over the center as it were, resulting in the speed of the wheel falling below normal, which the governor attempts to correct and in doing so pulls the nozzle back over the center again giving excess speed. The process is again repeated and the "see-sawing" is under full sway to the utter defeat of satisfactory operation.

The means by which the Lighthipe governor obviates these two troubles will be understood by reference to the accompanying illustrations, from which it will be seen that the fan-like disc operated by the crank attached to the traveling nut on the extension of the armature shaft, controls the elevation of a lever that is parallel with and secondary to the governor lever. This disc constitutes a cam of varying radii as shown in exaggerated form in Figure 2 and is so adjusted that as soon as the circuit of the pilot motor is closed by the governor lever the movement of the cam by the traveling nut raises or lowers the governor lever in such a way as to break the contact before the water wheel has been brought to the desired speed, thus compensating

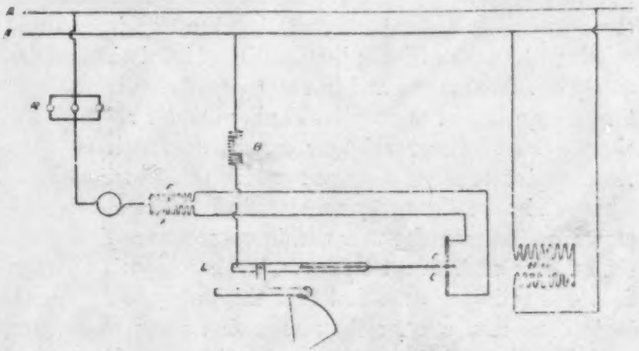


FIG. 2—OUTLINE DRAWING OF THE LIGHTHIPE WATER WHEEL GOVERNOR.

for the inertia of the moving masses and endowing the governor with a mechanical perception of far greater sensitiveness than that heretofore attained.

The diagram appended hereto as Figure 2 will make clearer the electrical connections and operation of the governor:

A A are the mains from the exciter or other source of direct current supply.

R is a lamp resistance to reduce the current rush on closing the circuit.

F and F are the field coils wound in opposition, and constitute the device for securing reversal with only two contact points.

L is the lever operated by the centrifugal governor.

C and C are the contact points lying within the pole pieces of the blow-out magnet B O, which was added to break the destructiveness of the arc at the contact points.

B is the brake soleniod in series with the motor circuit and arrests the momentum of the armature by bringing it to an instantaneous stop upon breaking the motor circuit.

The governor is exceedingly sensitive and may be adjusted to any desired degree of sensitiveness by adjusting either the contact points C C, or the link forming the fulcrum between the governor lever and the cam lever, shown in Figure 1. The contact tips may be adjusted to within 1-16 of an inch of contact, so that the slightest change of speed will throw the motor into action one way or the other. The ingenious mechanism accomplishes a closeness of regulation heretofore unattained; and while designed primarily for the control of water wheels, driving electric generators, it may be used with equal satisfaction in any class of work, as the governor can be operated from a simple battery circuit, as well as from an exciter or an incandescent lighting service.

ELECTRICAL COAL CUTTERS.

One of the largest coal operating concerns in Ohio, Messrs. Ellsworth, Morris & Co., have decided to cut their coal by electrical machinery. The system to be employed is the three-phase system of the General Electric Company, and the plant will consist of one 135 H. P. electric generator and eight coal cutters of the new induction motor chain type. These will be placed in two mines at Trail Run and Hartford, O., distant from each other 2½ miles. The power house will be located centrally and the current will be carried for nearly two miles, over aerial wires, which will be run through drill holes into the entries of the mines and be carried to the various points where the cutters are employed. Naturally such an order as this was not secured without competition, and induction motor cutters were adopted in place of the direct current motor cutters, for the reason that, compared with the latter, the former is lighter in make, many characteristics rendering the method of applying power to the cutter superior, decreases the amount of copper required to equip the mine, has no commutator or brushes demanding constant attention, has no starting rheostat and does not spark. The fact that the operative is not called upon to devote part of his time to attending to a brush and commutator mechanism, but can outline his work uninterruptedly is an important desideratum.

The Hutson Coal Co., owning and operating coal mines at Deerfield, Portage county, O., has also adopted electrical apparatus for cutting its coal. The plant consists of one 100 H. P. three-phase generator and one six-foot coal cutter. The particular mine in which the cutter is working has just been opened. The entry is driven in only a few hundred feet and there is only room at present for one cutting machine.

WHEN WATER POWER MAY BE USED TO ADVANTAGE.

It should be advantageous to use water power when it is cheaper than any other source of power and equally reliable. The cost, however, depends largely on the question of availability. All comparisons are naturally made with steam power, which can be furnished in any location, in any desired quantity, at a cost fixed by the particular conditions. The water power may not be in the location where power is desired; the quantity of power required may not be sufficient to warrant the development of the water power by a single manufacturer, and there may not be sufficient demand for power in the particular location to warrant the development of a special company. When, however, such development has been made, a new set of conditions is set up.

The water power can then be sold, at the site, in quantities small or large, like any other commodity, and, moreover, the later developments in electricity have made practicable the transmission of power to a distance where it can be utilized in large or small units. Under such circumstances, the transmitted power is brought in competition with steam power, either as a substitute for established steam plants or as the original source of supply for new enterprises.

In order to make it commercially desirable to develop a water power there must exist, first, a demand for power in considerable quantities; second, an available water power within a reasonable distance of the center of demand, and third, economic conditions which will enable the power when transmitted to compete with steam engines where the power is required.—Dr. Charles E. Emery in Cassier's Magazine.

THE JOURNAL OF ELECTRICITY.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

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F. A. C. PERRINE, D. Sc., and GEORGE P. LOW.

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EDITORIAL.

THE VALUE OF COLLEGIATE TESTS

We are constantly noticing in the papers before the electrical societies important tests made by the laboratory forces of many colleges which would be of great interest and value were it not for fact that the names of the makers of the various pieces of apparatus tested is most carefully suppressed. The question at once arises as to whether the engineers making these tests are to be considered scientific investigators as they announce themselves or paid as experts in the hands of the companies. It is as much the part of the special advocate to suppress facts of use to the world, which he discovers, as it is for him to misrepresent the truth concerning tests made, and it is hard to say by what chain of argument these scientific instructors who are continually engaged in suppressing facts concerning the tests they are making justify themselves in any such course of action. We generally consider that college instructors are incapable of being purchased outright, but is it not a fact that by gifts of apparatus and favors to the colleges and to the instructors the manufacturing companies are purchasing the silence of those men who should be our guides in determining the best apparatus to be used and the best engineering methods to be employed for accomplishing a definite purpose. It is hardly surprising when we find technical journals which depend for an existence upon the patronage of their advertisers endeavoring to shield the makers of inferior apparatus, though this has been considered for many years a blot on the face of technical journalism and where the instructors of the country use similar methods we must all feel that the position of a teacher has lost much of its dignity and independence. It is true that instructors are often more poorly paid for their services than they would be paid for a similar ability used in business, but this fact is often explained by the desire for independence in thought and speech which such positions are supposed to confer, and if it is no longer true that in the college professor we can find an independent investigator and a fearless teacher of truth, we who are engineers must consider that one of our most valuable means of guidance has gone from us. Colleges are not established for the private information of individuals, but are established for the benefit of the community and sooner or later our instructors must find that they have departed from their true mission by not adhering to those principles.

A WORD OF CAUTION

The extreme depression in business of the past two years has resulted in reducing the prices for all materials to an enormous extent,, but at the same time it has been taken for granted by engineers that there has been no corresponding reduction in the quality of the materials furnished. We understand, however, that wire manufacturers have recently privately announced that they are unable to fulfil existing contracts with the best quality of insulation, particularly in rubber wires, and in some cases it has been found that the quality of these wires has been so far reduced that change can be discovered by a casual examination. Electrical engineers are very prone to assume that the quality of a material once shown by an electrical test is always preserved by the manufacturer and in consequence they avoid the expense of frequent testing. We have continually endeavored to impress the fact that this policy is an exceedingly dangerous one for the reason that no manufacturer, even with the best intentions, can continually deliver a uniform product while we all know that many manufacturers have not the intention to preserve high quality where they believe that inferior goods will not be detected. If continual tests of quality are obtained it is possible always to buy materials in the absolutely cheapest market, but it is always dangerous to accept a low bid where such tests are not possible, and at the present time when competition is keenest and when insurance inspection in the Far West is a thing of the past, it seems particularly necessary to caution those purchasing insulated wire against inferior products which have apparently become almost a necessity in the market by reason of the extreme reduction in prices.

A WESTERN ASSOCIATION PROPOSED

Proposals for the establishment of an association embracing the operators of electric light plants on the Pacific Coast have been made from time to time, but no such proposals have been received with great favor on account of the fact that the distances to be covered by the members of the association in attendance on its meetings would be necessarily great, while it was at the same time felt that on account of the comparative smallness of the installations little valuable information would be gained at such meetings to repay the members for the time and expense of attendance. During the past year striking changes in the electrical situation of the Pacific slope have made the organization of

such an association more important, if indeed not almost imperatively demanded.

Business arrangements between the electric and gas lighting companies have so far harmonized their differences that we understand the Pacific Coast Gas Association is considering the advisability of opening its doors to the managers of electrical undertakings and the great developments in power transmissions that have taken place have opened up problems in relation to water powers, long distance transmission, underground cables and many other minor points which are not discussed before the Eastern societies, for the solution of which the managers of the Pacific Coast could confer to their mutual advantage. It seems therefore a fitting time to urge upon the managers of electrical undertakings here the advisability of an association including in its membership all managers of electric plants, operators of gas plants, and of water power transmissions as well as independent electrical engineers and electrical supply houses. An association comprising such an aggregation in its membership should be formed on a basis of more than a single class of members such as is the practice of the National Electric Light Association, whose experience has proved the wisdom of the plan. The attendance of the electrical engineer and supply man adds much to the interest of the meetings in general, but at the same time it is not wise to give these members full membership rights for the reason that the temptation would be offered to mould the association along special lines and to give it a special bias which would undoubtedly impair the usefulness of the association to its general members.

Whether the proposed association could be operated more satisfactorily as a branch of the N. E. L. A. by an expansion of the Pacific Coast Gas Association or by the formation of an independent new body is a question for discussion amongst the possible members. We accordingly invite from the managers of such plants as would be included in the outline we have given an expression of opinion concerning the advisability of a Pacific Coast Electric Light Association and an expression of judgment concerning the lines on which such an association could be operated most satisfactorily.

PROBLEMS IN CONDUIT CONSTRUCTION

At the present time there is an exceedingly rapid growth of extensive long distance transmission systems, but only recently have the companies operating these systems been compelled to face the problem of city distribution. Now that such work is generally contemplated operators are called on to determine the best means of transmission through a city street. The days of overhead pole line construction may now be considered as permanently past, and while the best system of underground distribution for a large city is undoubtedly found in the pipe conduit, electrical engineers have not yet determined whether it will not yet be possible to introduce an equally efficient and less expensive construction where smaller cities requiring a smaller number of wires and less conduit capacity have demanded underground construction. The pipe conduit demands deep trenches and manholes of such a size that they may be considered as work-rooms; these manholes being located not further apart than the length of a city block, which will average about 400 feet. The size of a manhole does not depend upon the number of conduits used in the system, but upon the fact that sufficient room for the cable splicer must be furnished and accordingly the cost of this construction per unit of electricity supplied by the city mounts rapidly as the extent of the system decreases until in a small distribution such construction reaches an almost prohibitive cost. In the East this problem has not been encountered for the reason that the smaller cities are not demanding underground construction, and in consequence conduits are rarely found in cities of less than 200,000 inhabitants. On the Pacific Coast such cities are our most important centres of population and have very properly demanded underground wires wherever an extensive power transmission system has been contemplated.

Up to the present time such a demand has been met by burying the cables in wood boxes or in grooved planks, large amounts of such construction having been installed. The cables employed are of the best lead covered construction generally insulated with rubber and obtained from the East at a cost which is very great when we include the price of the cable, freight and the expense of splicing. While these cables are well spliced and are originally of the best manufacture, the conduit construction here used is one which has been universally condemned for many years. In the first place the wood used for trench boxes or for grooving has rarely been thoroughly dried and saturated with a preservative compound while little attempt has been made to exclude from the construction gases and liquors contained in the soil. All of the best experiments in underground construction have proved that wood contains acids injurious to the lead, and that the soil of a city is fatal to its life. In consequence no system of construction may be considered secure which does not require both the elimination of the wood acids from the conduits and the prevention of access of the products of the soil from the ducts. In consequence we may easily foresee much difficulty with all cables that have been laid here during the past two years from the destruction of the lead casing and of the insulator which it is protecting. It is, however, not accurate to suppose that the recognized manhole and duct construction of the East is necessary to overcome this difficulty, but on the contrary where distributions in small cities are contemplated we must look for information to the experience abroad where such installations have been made rather than to the experience of the East where they have not been attempted.

Two methods of construction unused at the present time in America are noticeably successful in other countries. The first of these consists of the burying of cables carried upon insulated supports in a trench filled with asphaltum. Such a method should not be expensive here where asphaltum of a good quality is a native product, but much study must be devoted to the system before it can be made successful. Failure has often resulted from the use of permeable supports for the conductors and from unsatisfactory cables and cable joints, so that the construction is dangerous where it is impossible to apply accurate insulation tests throughout the whole process of cable construction.

The other method which is undoubtedly successful is only adaptable to secondary distribution from sub-station transformers and consists in the use of something similar to overhead construction in large closed trenches which are made impermeable to moisture from the outside and readily drained from that which condenses in the interior. In this system bare conductors are used and there is a consequent saving of freight in addition to the saving in the cost of the insulation itself.

This problem calls for a solution by the engineers of the Pacific Coast and requires the care that only an engineer is capable of giving, but is worthy of consideration by every company endeavoring to install underground conductors for power and light transmission within the bounds of any of our cities.

Passing Comment

An Editorial Review of Current Events and Contemporary Publications.

PHOTOGRAPHY TO THE RESCUE.

An ingenious solution of the note collecting problem is explained by Reginald Fessenden in the "Electrical World" of August 22nd. Every engineer who has attempted to preserve the information contained in several technical journals has felt the burden of any scrap book or similar method while the extent of indices or digests must necessarily be limited by the amount of time possible to devote to such work. Prof. Fessenden has attached to his desk by a universal joint, a small camera capable of taking a picture 1x1½, and with this he photographs all articles, tables or diagrams he wishes to preserve, filing the negatives on a card index system. In this way he preserves true fac similes of all matter which appears to be of interest to him, and he states that the amount of time and expense entailed in the process is less than that of any known system; indeed, he goes to the extent of saying that he can copy letters by this method more cheaply and expeditiously than is possible with a press. The great defect in the method appears to be the smallness of the plates used, requiring a magnifying glass for reference to the articles where pages 10x12 are to be copied, but this difficulty is a minor one, and the size of plate used can be considered as a matter of individual convenience. Should it be possible to copy with plates 3¼x4¼, the negatives would occupy the same space as the ordinary card used in a card catalogue, and the additional uniformity might be desirable. Such labor-saving systems are important to every engineer, and we do not remember having seen one which appears to embody the principles of expedition and convenience more satisfactorily.

THE CAST-WELDING OF RAILS.

When first the mechanical success of the cast welded railroad joint seemed to be assured no doubt was felt concerning the electrical conductivity of such a great mass of metal, but from recent numbers of the Street Railroad Journal we would gather that there have been doubtful cases of high resistance with such joints, and there seems to be a growing feeling that the cast-welded joints cannot be safely employed without bonding for electric conductivity. This is on account of the fact that the rail expands during the casting and on cooling contracts to such an extent that intimate contact between the joint and the rail is lost; indeed the permanence of the cast-welded track above a track electrically welded is sometimes explained by this fact that the cast joint allows the rails to move while the electrically welded joints hold them in place and produce breakages when cold weather occasions contraction.

The theory of the cast-welded joint is that an alloy of the cast and wrought iron is made at the temperature of casting, but when previous experiments in uniting cast and wrought iron are examined it is found that such an alloying does not take place unless the amount of wrought iron present is small in proportion to the mass of molten cast iron, and as this is not the case in the cast-welded joint, it is not surprising to find that the contact between the two lacks in conductivity. Much difference in opinion is expressed by the many correspondents of the Street Railway Journal in reference to this point, but the fact that such a doubt concerning the process has been brought out by many accurate observers renders caution necessary in the use of this joint without bonding and requires further information before we can state surely that the cast-weld is the solution of the track conductor problem.

BOILER SCALE AND STEAM EFFICIENCY.

Discussing the subject of boilers and feed water recently, Professor F. B. Crocker made some terse remarks on the subject. The water used in steam boilers is obtained either from the regular city water supply or from some source such as a pond, river, or well. Which of these is best to employ depends upon the circumstances in each particular case, but in almost every instance the question of the purity of the water is an important matter. Almost any water available for use in boilers contains from 10 to 100 grains of solid material per gallon, and since a 100 horse-power boiler evaporates about 30,000 pounds of water per day of ten hours, or about 400 tons per month, the accumulation of this material becomes very considerable, assuming only half of it to be deposited: Impurities of water are of two distinct kinds: First, small particles of solid material mechanically held in suspension, the presence of which is perfectly evident to the eye, forming what is called, in plain language, muddy or dirty water. The other class of impurities are mineral substances dissolved in water, producing little or no change in its appearance or transparency. Impurities of the first kind can be removed by filtering, or by simply allowing the suspended particles to settle; but impurities actually dissolved in the water can only be eliminated by some process of chemical or physical precipitation. The so-called "hard water" is simply water containing compounds of lime, magnesia, etc., in solution, which are particularly objectionable in water for boilers, since they are deposited as a scale or incrustation upon the interior, and seriously interfere with the transmission of heat through the metal, there-

by reducing the efficiency of the boiler and also introducing a danger that it will become excessively heated and weakened. These deposits in boilers sometimes reach a thickness of half an inch or more, and are extremely troublesome and difficult to prevent or to remove after they have formed. It is estimated that scale one-sixteenth of an inch thick necessitates the use of about 10 per cent more fuel, one-fourth inch almost 40 per cent more, and half to three-quarter inch scale actually doubles the amount of fuel required to generate a given quantity of steam. These facts, and the greatly increased repairs and danger arising from scale in boilers, show the great importance of eliminating it.

ROPE TRANSMISSION.

In the London "Electrician" for August 14th we notice the abstract of a paper by Alfred Combe read before the Institution of Mechanical Engineers on experiences obtained in the rope driving of machinery. Many important points are covered and some startling announcements of practical results are given. The author is a son of the James Combe who, in 1856, first used rope driving for large powers in England, installing in 1863 a 200-horse power plant in a foundry plant which is at the present time still in operation. Lacking previous experimental information the Combes instituted a series of trials, the results of which are now announced and which, as we have said, present some remarkable conclusions. In the first place the speed of rope for maximum life and efficiency is given as amounting to only 3,300 feet per minute whereas the common practice is run ropes as high as five or six thousand feet per minute. With such a low speed of rope the power transmitted with any given rope is obviously much diminished and also the pulley sizes must be increased for fast driving. This result is partially counteracted in relation to the size of the pulley by the statement that pulleys only from 28 to 36 times the diamater of the rope are considered by Combe to give the best results, whereas engineers have generally thought that satisfactory life of rope could not be obtained with pulley diameters less than 35 times the diameter of the rope; still, as the ordinary life of a cotton or manilla rope is generally taken from at six to ten years there seems to be a margin in this direction which has been taken advantage of by Combe in his slow speed driving.

A few years ago rope transmissions were claimed to be more economical than belt drives, but recent practices have not borne out this claim, and it would appear from the statements made by this author that a mistake has been made in driving the ropes too fast and losing too much by inertia and centrifugal action. For large powers, rope drives are undoubtedly the most quiet and permanent, the system being one well adapted to the driving of large units from water wheels, while from the experience obtained in the direct connection of water wheels and electric power units we know that the hopes of the advocates of direct driving have not been sustained. May we not expect a return to indirect driving, allowing more economical wheels speeds and speeds of dynamos, even though this conclusion of Combe as well as those of other engineers using rope transmission must be carefully considered before we can conclude that we have arrived at the greatest economy obtainable with rope transmission.

THE ONLY HOPE FOR MUNICIPAL OWNERSHIP.

The "Street Railroad Journal" has been recently calling attention to the success of the well appointed systems of the street railroads in European cities and at the same time the electrical fraternity in general has been discussing the surprisingly good financial showing of the Manchester municipal illuminating plant. On this side of the water, however, the technical journals have been occupied chronicling the failure of municipal plants and calling attention to the numerous accidents involving loss of life and destruction of machinery on the trolley roads throughout the country. These striking facts lead us to examine very carefully the differences in the municipal management of the cities of the United States and those of the Old World, examination showing at once that the business methods of the municipality of the European cities partakes of the character of their business houses, while with us municipalities are governed by politicians from whom no business ability is expected. In consequence we find in Germany the heads of the Public Works departments are without exception efficient engineers, and where municipal plants are established the best engineers of the country strive for the managements because such positions involve the greatest security of employment and allow the best exposition of ability. In rather painful contrast with this is the fact that in this country the offices are sinecures and easily obtained through personal influence. When a franchise is granted to a street railroad in Germany the plans are considered by all the engineers in the city employ who may be directly or indirectly concerned in the effects of its management, and in consequence the peace of the community is assured and the rights of the railroad are well laid down and duly respected. This would only be possible where the different heads of departments thoroughly understand the bearings of their work and that men of such ability are secured by the municipalities determines at once the success of their municipal undertakings. Theoretically there is no reason why a municipality should not do business as cheaply as an incorporated company, but such results can only be obtained where it is possible to divorce the business and engineering management completely from the field of politics and the caprices of election.

CONCERNING SWITCHBOARD DESIGNS.

It must be evident to anyone who has had occasion to examine the arrangement of switchboards that are from time to time published that convenience of installation and ease of manufacture are of more importance to switchboard designers than ease of handling and systematic design. This is still true notwithstanding the fact that the last three or four years has seen great development and advance in the making and laying out of switchboards. Certain ideas belonging to the manipulation of the most primitive electric lighting stations have been preserved in modern installations although these ideas seem often not to be justified in modern practice; among these earliest original conceptions we may include the installation of all apparatus on the positive side of the circuit, the arrangement of ammeters and

voltmeters to be visible at a great distance, the location of the rheostats at the bottom of the board and the installation of lightning arresters in the station on the board. To be sure some of the modern switchboard constructors have recognized the incorrectness of parts in these designs, particularly in the case of the location of lightning arresters and have introduced radical departures, but it is rarely that we find a switchboard so designed that the instruments affected by every switch and rheostat handle upon the board are so located that they may be easily observed by the switchboard attendant at the time that he is throwing the switch and manipulating the rheostat. Perhaps the extreme absurdities once common, of locating the various pieces of apparatus on the switchboard as to require the services of both an observer and a manipulator have been done away with, but we think that switchboard designers have not yet fully realized the importance of the switchboard attendant in the economy of a great central station, and it is by no means infrequent to find the attendant walking back and forth between his instrument and rheostat over a distance of from ten to twenty feet. Perhaps this is due to the fact that the switchboard attendant is generally considered to be a servant of the chief engineer and the chief dynamo tender rather than of the master of the station. But will we not in the future distinguish the importance of giving one man the entire command of the station having all the indicating apparatus under his eye and himself in the position of switchboard attendant.

If this radical change were effected and switchboards so designed as to make the apparatus easily read by the attendant, without reference to engineers or dynamo tenders at a considerable distance, great advantage would be gained in saving the cost of large instruments, long and complicated switchboard wires, and it would place the responsibility of the whole station upon the shoulders of one man. This responsibility could not be undertaken by the present class of switchboard attendants, but the change would allow the employment of a smaller number of expensive foremen throughout the station, while it would place the manipulating apparatus of the whole plant at a distance from the point of danger whenever mechanical or electrical accidents should occur. The system may be one implying a radical departure from the present methods of manipulating central stations, but it would make central station practice more nearly similar to mechanical practice, which has been tried and found sufficient in large power stations, such as ships, rolling mills, steel furnaces, in all of which systems the constant endeavor is to locate the responsibility and centralize the power of manipulation; such an arrangement having been found less liable to occasion accidents and one which reduces the importance of those unavoidably occurring.

John B. Fisken, General Manager of the Washington Water Power Company of Spokane, Wash., says: "I wish to compliment the style of The Journal of Electricity, which both as regards the general get-up and the matter contained therein, I consider equal to anything published in the country to-day, and I trust that it is proving to be the financial success which it ought to be."

Literature.

Any Book Published Mailed upon Receipt of Price by The Journal of Electricity.

"THE THEORY OF THE STRUCTURE OF MATTER." By James S. Alden, M. E., Passaic, N. J. Published by the author. 45 pp. Price, 50 cents.

In his introduction Mr. Alden states that: "He has spent nearly seven years in developing this theory, which is based on the assumption that an atom of matter 'consists of a vortex ring of luminiferous ether,' and as a conclusion of his seven years of study, he states: "That the combined teachings of the Bible and science seem to indicate that Faith and Ether are one and the same thing; the unit of biological being seems to consist of matter held in the form of a histological cell by spirit." It is hard to understand, however, from his more or less mathematical conclusions where he obtains the connection between Faith and Ether. Though the theory of the constituion of the matter given is not unsound should his fundamental assumptions be granted, but these assumptions involve the oft-disputed values of the density and the elasticity of the ether which, in all the conclusions, occur as a product, and which subsequently cannot be separated or evaluated except in speculation, unless some crucial tests could be imagined and performed. Lord Kelvin and Von Helmholtz have both made mathematical investigations of these questions, but never have been able to point to a possible system of experiments which would determine the disputed points, and Mr. Alden's investigations seem to leave the matter in exactly the same position as the ether vortex theory has held for the past ten years. To any one attracted by this form of speculation the pamphlet will form pleasant reading, and it may be instructive to any student who desires to apply himself carefully to such speculative reasoning. The fact that the phenomena of electricity are explained by Mr. Alden's theory does not aid us in the solution of any particular electrical problem, nor can we see that it has advanced the theory of electrical action beyond the point where Lodge carries the theory in his book of Modern Views.

APPARATUS FOR THE TRANSMISSION OF POWER BY TWO-PHASE ALTERNATING CURRENTS. Stanley Electric Manufacturing Company, Pittsfield, Mass.; 62 pp. Printed for free distribution.

This catalogue describing the "S. K. C." system of two-phase alternating current machinery is one of the boldest of the catalogues issued by any company,—boldest in its distinct claims for a special type of apparatus and in its clear cuts and descriptions of the apparatus manufactured by the Stanley Electric Manufacturing Company. In the introduction the claim is made that their apparatus is of high class and sold at a fair manufacturing profit, which at the present time is equivalent to a high price; this claim being substantiated as we all know by the business practices of the Stanley Company. The fact that this company has not been compelled to enlist in the ruinous competition that has been so disastrous in all lines of business during the late period of depression is one of the encouraging signs to all good engineers, proving that the market for good apparatus commanding good prices has not yet been completely lost.

The distinctive points of the "S. K. C." apparatus are first, the induction generator having no moving wire and requiring no compounding for close regulation; secondly,

the adherence to the true sine curve in the e. m. f. wave; thirdly, the complete electrical independence of the two phases from the machine, and finally the use of the condenser in induction motor installations. When this company first began to manufacture condensers for connection with induction motors it was opposed on both sides of the Atlantic by both theoretical and practical men; the first attempting to prove that the condensers were both useless and dangerous, and the second declaring that no condenser could be manufactured which could continuously withstand the demands of actual service. Both of these contentions have been disproved by the Stanley Company, until now no one dares any longer to contend that it has not successfully withstood the demands and solved the problem of overcoming the self induction of the motor by an auxiliary capacity along safe and practical lines. In fact, during the last three years the extension of this company has been more rapid than that of any other company installing polyphase machinery, which is sufficient proof of the practicability and success of the system. Many small towns throughout the East are installing Stanley apparatus where a motor load does not exist or is insignificant on account of the fact that while for lighting the Stanley machine can be considered as two single phase alternators, connections for power distribution can at any time be easily made, and any such demand be readily and efficiently met by these machines without serious disturbance of the lighting potential when large synchronous or induction motors are operated. A consideration of the claims of the Stanley Company is of great importance to every transmission plant, and as a means of transmission its machinery will continue to prove to be of the greatest importance to engineers of the Pacific Coast.

THE ENERGY OF A THUNDERBOLT.

Modern scientific discovery is fast unraveling the greatest mysteries of nature, and it now appears that there are but few things that are hidden from the gaze of him who looks for them in the proper way. Lightning was formerly one of the greatest enigmas among natural phenomena. Today we know that the average electromotive force of a "bolt" of lightning is about 3,500,000 volts; that the current is 14,000,000 amperes, and that the time of discharge is about one twenty-thousandth of a second! In such a "bolt" there is energy equal to 3,284,182 horse-power.

THE LIGHTNING BUG.

(With a Moral.)

The lightning bug is brilliant,
But it hasn't any mind;
He blunders through existence
With his headlight on behind.

—Chicago Record.

Just so the foolish merchant,
Whom no one can advise;
For he decided years ago
That he'd never advertise.

—Electrical Review, N. Y.

So now he's made a failure,
Which he cannot grasp "de tout;"
'Twas just because he managed
Things backward—hind-end-to.

—Journal of Electricity, S. F.

Transmission

ANOTHER BIG TRANSMISSION FOR SALT LAKE

The most notable power transmission plant yet attempted, both from the point of view of amount of power and the distance of transmission, is already under way in the State of Utah.

The Pioneer Electric Power Company of Ogden, Utah, has within the past month placed a contract with the General Electric Company for a complete 5000 H. P., three-phase plant, covering a transmission of 36 miles, from Ogden to Salt Lake City.

The power will be obtained from the fall in the canyon of the Ogden River, at a point almost within the limits of the city of Ogden. Across the head of the Ogden Canon a dam is to be thrown, and an immense storage reservoir formed, which will cover some 15 or 20 square miles of a valley in the mountains. From this dam to the power house is a distance of nearly six miles. The water will be carried through a six-foot pipe of wood for about five miles, while for the rest of the way it will pass through a six-foot pipe of rivetted steel. These pipes are fitted at intervals with automatic relief and air valves to prevent the bursting or collapsing when the flow of water is varied by changes of load. The effective head of water at the power house will vary from 400 to 450 feet, and the full capacity of the pipe line will be 10,000 H. P.

Two duplicate receivers will be used, one at each side of the power house, so that either can be shut down without stopping the plant. To these the pipes running to the water wheel nozzles will be connected. The speed of the wheels will be controlled by Knight governors and the valves will be operated by hydraulic pistons so that the generators may be stopped and started from the switchboard. The water from the wheels on each side of the power house will pass into a central tail race under the floor between the two lines of generators, and will be conveyed into canals for the irrigation of some 18,000 acres of land in the vicinity of Ogden, which will be reclaimed for farming purposes.

The electric plant at first will consist of five 1000 H. P. 24-pole, three-phase generators, driven by Knight water wheels running at 300 revolutions per minute. The water wheels and fitting will be furnished by the Risdon Iron & Locomotive Works of San Francisco. The water wheel and armature are to be mounted on the same shaft, and will be supported by the same base frame and bearings. The periodicity of the current is 60 cycles per second, and the generators will be wound for 2,300 volts. Two exciters, each of 100 K. W. capacity, direct, connected to their own water wheels, will be provided, either of which will suffice to excite the fields of all the generators in the completed station.

The current from the generators will be carried by lead-covered cables laid in ducts between the generator foundations and the wall of the building, to the generator switchboards at one end of the power house. The boards will be blue Vermont marble panels, and will be completely equipped with all the necessary controlling and regulating instruments and apparatus. Tachometers on the switchboard, operated by Synchronous motors electrically connected to the generators, will indicate the speed of the machines.

The step-up transformers and the 2,000 and 15,000-volt feeder panels will be placed in a gallery erected over the generator switchboard. The transformers, nine in number, each of 250 k. w. capacity, will raise the generator potential

from 2,300 volts to 15,000 volts, at which pressure 2,000 H. P. will be transmitted to Salt Lake City. The local distribution of the balance at Ogden will be made at 2,300 volts.

The transmitted current will pass over six No. 1 wires strung on insulators of a special porcelain, developed by the General Electric Company, to withstand high potentials, to nine 250 k. w. step-down transformers at Salt Lake City, which will deliver it at 2,300 volts for distribution.

The transmission line and transformers will be arranged to allow of the use of a potential of 25,000 volts. This will permit of the efficient transmission of current to the mining regions of Mercur and other camps thirty to thirty-five miles beyond Salt Lake City. All lines will be protected by the latest types of General Electric lightning arresters, which have proved so efficient in the Folsom and other transmissions.

To construct the iron and wooden pipe bringing the water to the wheels 100 h. p. in motors are set up in the shops of Rhodes Brothers, in Ogden, supplying extra power for the work, which is one of the most extensive pipe line contracts ever undertaken—five miles of six-foot wooden stave pipe, and one mile of six-foot rivetted steel pipe. Practically all the work will be done on the ground, the steel being received in flat sheets, to be rolled, punched and rivetted in the shops and the lumber for the wooden pipe in the rough to be milled, planed and put together on the spot.

Salt Lake City, with the completion of the Pioneer plant, will receive power from two of the most important electrical transmission installations ever undertaken. That transmitting the power from the Big Cottonwood Canon has only recently been completed, that of the Pioneer Company will probably be inaugurated about the first of November of this year.

A NOVEL SHUT-DOWN.

For two hours and a half Monday night the electric lights went out in Pendleton and the city was in total darkness. The explanation furnishes an account of a very peculiar occurrence, which would not happen at any station more than once in its history. During the evening the lights began to grow dim, and the station men thought the wires were grounded, and as a consequence the engine was overloaded. The incandescent lights were first turned off, but that did not remedy matters. The large driving belt connecting the engine with the dynamos was running in a most peculiar manner. It was jumping up and down and striking the stone work as it had never done before. Then the arc dynamos were cut out and the engine shut down.

William Burgess, the superintendent of the works, had come up to the station to see what was the difficulty, and he soon discovered that the big belt was literally lined with thousands of the white millers, which are now so numerous in Pendleton. One by one, dozen by dozen, the millers had flown into the open window, and had been drawn by suction into the belt until it was one mass of crushed millers.

Chalked cloths were in use in wiping the belt, and at 12:45 this morning the lights were again turned on. During the remainder of the night no more trouble was encountered.—Pendleton (Ore.) East Oregonian.

THE CHLORIDE BATTERY AGENCY GIVEN.

The sole agency for the Pacific Coast for the Chloride Electric Storage Battery has been given to the Union Iron Works, of San Francisco. Mr. A. E. Brooke-Ridley, the well known agent of the Siemens-Halske Electric Company, has been appointed general manager for the Chloride agency, which is now prepared to fill orders promptly from stock.

The Lay Press.

POPULAR REFLECTIONS OF THE CONDITIONS AND PROSPECTS OF ELECTRICAL ENGINEERING ON THF PACIFIC COAST.

The construction of the immense plant of the Mariposa Electric Power Company, and the harnessing of the mighty waters of the Merced river, hitherto allowed to go to waste, means much for Mariposa. Valuable gold mines that are now lying idle and unproductive for the sheer want of power to operate them will be opened up, giving employment to hundreds of men. Large mills will be erected to handle the products of these mines, and the roar of stamps and the whir of machinery will be heard throughout the length and breadth of the land, demonstrating the fact to the world that in Mariposa county is indeed "California's richest gold field." The building of this vast power plant is not an idle rumor, it is a real thing, and prominent and influential men of wealth of San Francisco are interested in the enterprise, and it will not "go through" for the want of money to carry on the work.—Coulterville (Cal.) Miner.

People who have experienced any trouble with street-car employees, and they are legion, will be interested in a little "letter" that has just been issued by the Haywards electric road. It marks a progressive step, both in the prestige and deportment of motormen and conductors. It commences by stating that the advice if followed "will be of great benefit to you and will tend to make you more useful to the company."

Above all things, the company does not want "cranky" men, although it expects every employee to be thoroughly familiar with all the cranks and wheels of the machinery under his control. A conductor must certainly have a temper like Job if he honestly acts up to the advice regarding being pleasant.

"When asked for information," it says, "hasten to give all that you can. A conductor can, by being cranky, drive travel from the railway, just the same as a clerk in a store can drive trade away.

"Urbanity is capital, without which no business can be successfully carried on.

"Passengers do not always like to make requests, and their wants should be anticipated.

"Do not get out of temper when a passenger happens to take offense, but rather make an effort to appease him and please him."

Something new is found in the rule about putting an obnoxious passenger off the car. Before ejecting him the conductor is to use every means to pursuade him to be a gentleman, and if this has no effect then return his fare and bounce him. The return of the fare is a new feature.

The poor conductor has another task which is not any more pleasant. He is advised as follows:

"Should a light of glass be broken while a car is in your charge, endeavor to collect $1.50 from the person breaking it. If he refuses, ask him his name and address, and when you turn your car in make a full and detailed account of it and drop it in the timecard box.

"No conductor is to discriminate between the lady who is fair, fat and fifty, and the dainty maiden who is attending a picnic at San Lorenzo Grove." He is told to be "ready" at all times to assist ladies, both old and young, in alighting or getting on a car; also to help them with bundles, etc., always to be careful when assisting a lady to do so in such a manner as not to give offense. Always try to find seats for passengers by making children "double up, or by having their parents take them on their laps."

The conductor is dismissed with one more word of advice, doubtless the result of a talk to a newspaper man in the past.

Here is the rule: "You must not, under any circumstances, discuss an accident, excepting when ordered to do so by the Superintendent."—San Francisco Call.

Personal

Mr. John I. Sabin has returned to San Francisco after spending the summer in Europe.

Dr. Thomas Addison, manager of the San Francisco office of the General Electric Company, is now in the East, and will probably not return before the middle of October.

Mr. Keijiro Okamoto, of the Department of Communcations, Tokio, Japan, and who has been in the United States for several months past on a tour of investigation, has returned to his own country.

Mr. L. J. Grimesey, of the firm of Bagnall & Hilles, of Yokohama, Japan, has been in the city for the past few days, with headquarters at the offices of the New York Insulated Wire Company, No. 18 Second street. Mr. Grimesey will visit the principal Eastern cities before returning to Japan.

Mr. H. H. Morehouse, of the firm of Morehouse & Morrill, which recently signed the contract for a complete hydraulic and electric installation costing $70,000, for the city of Antigua, Guatemala, is in San Francisco, and will place orders for materials for the plant referred to.

Financial

SAN JOAQUIN ELECTRIC COMPANY.

The San Joaquin Electric Company, of Fresno, Cal., operating the interesting and highly successful power transmission plant described in the April number of this publication, has issued a statement concerning its financial affairs, from which it appears that the total authorized bond issue of the company is $800,000, of which amount $350,000 has been reserved to meet the cost of future extensions as may be required, and can only be used under strict reservations. The present or first bond issue is therefore $450,000, maturing in twenty years and bearing 6 per cent interest. Four securities, as follows, are offered on the bonds:

First—The San Joaquin Electric Company has acquired $275,000, or nearly all of the shares of the Fresno Water Company, which has paid annual dividends of 5 per cent. and 6 per cent. for several years past, and which has often been called the model water works plant in the United States. Moreover, the recent introduction of electric power has reduced the operating expenses of the water company and materially increased its efficiency.

Second—Its entire new transmission plant built by the General Electric Company is now in highly successful operation, furnishing nearly all of the power and light used in Fresno, and yet using but practically one-fourth of the plant capacity.

Third—The title to valuable water rights on the North Fork of the San Joaquin river, the surveys, rights of way, construction work, real estate, etc., acquired, and also valuable city and county franchises and contracts.

Fourth—Contracts with the Sperry Flouring Company, the Fresno Water Company, and various other parties, all being held as security with the bonds.

The income and operating expenses of the company are stated to be as follows:

Income from the Fresno Water Company, on the basis of the year 1895	$12,000	
Sundry income contracts now on hand	42,000	
Estimated income from other contracts now being negotiated	6,000	
Present income	$60,000	$60,000
Estimated income from future contracts per engineer's report	$20,000	
Estimated saving of expense for fuel and engineers of Fresno Water Company	6,000	
	$26,000	$26,000
Total income		$86,000
Operating expenses during construction, first year	$16,000	
(Operating expenses after construction is completed is estimated at $10,000.)		
Interest on bond issue	27,000	
Fixed charges	$43,000	$43,000
		$43,000

The engineer points out that the income will increase each year and the expense will diminish after the first year, and it will be observed that without regard for future prospects the present income actually being collected exceeds by $17,000 the interest and expenses. The mortgage or trust deed is approved by the attorneys of the San Joaquin Electric Company, the Municipal Investment Company, of Chicago, and the Mercantile Trust Company, of New York, trustee. A portion of the bonds are offered for sale by the Municipal Investment Company, of Chicago.

THE SAN FRANCISCO GAS AND ELECTRIC COMPANY.

The San Francisco Gas Light Company, by J. B. Crockett, President, has issued a notice to its stockholders, as follows:

"For some time past here has been sharp competition in the lighting business between the San Francisco Gas Light Company and the Edison Light and Power Company. The Boards of Directors of the two companies, realizing that possibly in the future this might lead to serious loss to both companies, and that the business of furnishing light and power should be controlled by one management, and thus effect a large saving in the general management, establish more uniform rates between gas and electricity, and in many other ways curtail expenses, have deemed it advisable to form a new company, to be known as the "San Francisco Gas and Electric Company," and to transfer to this new company all the property of the other two. This agreement was reached after a patient investigation of the affairs of both companies. The books were experted and the machinery examined, and the result is that the Directors of this company now recommend to the stockholders that they agree to the formation of the new company, the general plan or prospectus of which is as follows:

"The new company to be formed from the other two companies to be called the San Francisco Gas and Electric Co. Capital stock, $20,000,000, of which $10,000,000 will be issued to the stockholders of the San Francisco Gas Light Company; $2,750,000 to be issued to the stockholders of the Edison Light and Power Company, and $1,066,666 2-3 to be placed in trust in the hands of a trustee selected by the directors of the new company, which said stock is to be placed in escrow for the purpose of redeeming the outstanding bonds of the Edison Light and Power Company. All the remainder of the stock is to be held in the hands of the company, and will not be issued unless necessity requires the same for the enlargement, exten-

sion or improvement of the plant. The San Francisco Gas Light Company, having but its current monthly debts to pay, could disincorporate and go out of existence, but as there are real estate and other assets remaining in the corporation, being the exclusive property of its present stockholders, it will not disincorporate but will reduce its capital stock to $3,000,000, which is sufficient to carry the real estate unsold.

"It will be necessary for all the stockholders of the San Francisco Gas Light Company to surrender their present stock and to receive in exchange therefor an equal number of shares of stock of the San Francisco Gas Light Company, representing the real estate interests, the par value of which will be $3 per share, and also to receive the same number of shares of the San Francisco Gas and Electric Company. You will see by the enclosed notice that, according to law, a special notice has been issued and will be published for the necessary time, sixty days, calling a special meeting for the stockholders, to be held on Monday, October, 26th, for the purpose of approving the reduction of the capital stock as mentioned above. At the same time it is desirable to get the consent of the stockholders to the transfer of all property rights, franchises and privileges of this company to the company to be formed. We believe that, with economical management, the new company will be able to earn and pay a fair dividend, and gradually be able to reduce the price of light to the consumer.

"This projected formation of a new company has received our close attention for the past year. We have carefully investigated every detail connected with it and we believe that this action if confirmed by the stockholders will be of great advantage to us all. Therefore, if this explanation meets with your approval we will be very glad to have you sign a proxy empowering the Board of Directors to carry this out, or if you can be present in person where we can give you a full and complete statement in detail of the matter, we should prefer that."

Reports of the Month.

COMMUNICATION.

RIVERSIDE, CAL.—The City Council will shortly add a number of new boxes to the fire alarm system.

LOS ANGELES, CAL.—A new district telegraph system is being organized for this city, and it is probable that the Salisbury & Dean Combined District Telegraph and Telephone System will be used.

INCORPORATION.

SAN FRANCISCO, CAL.—The Fraser Electric Elevator Company; capital stock, $100,000, of which $500 has been subscribed. Directors, E. M. Fraser, Geo. Crocker, Chas. E. Green, John J. Mahony and A. J. McNicoll. Mr. Crocker is President, Mr. Mahony Vice-President, and Mr. Green is Secretary and Treasurer. The office of the company is rooms 199 and 200 Crocker building, and the works are with A. J. McNicoll & Co., No. 124 Main street. The company proposes to build and install the differential electric elevator equipment described in a recent issue of this paper.——Mariposa Electric Power Company; capital stock, $1,000,000, in 100,000 shares at $10 per share, all subscribed by the incorporators, Augustus H. Ward, Geo. Ecker, Chas. T. Lindner, Wallace B. Taylor and Harold C. Ward. The proposed plant is to be located at the old Broad Bend dam in the Merced river in Mariposa county, whence power will be distributed to the mining industries in and about Coulterville.

LITIGATION.

PHOENIX, ARIZ.—The Hirschfeld Electric Light Co. is to enter suit against the City Council to restrain it from cutting certain wires that the company has extended beyond block 21, in which the company had received a franchise for operating an electric light plant for the use of its owner and others situated in that block.

LOS ANGELES, CAL.—Judge Ross, of the United States Circuit Court, has rendered a decision in the case of Chas. D. Ranning, receiver of the San Diego Land & Water Company, vs. H. C. Osborn et. al., to the effect that the company could fix the water rate in default of any order by the Supervisors to that effect. The suit was an injunction to restrain the defendant from bringing injunction suits against the receiver or the company, and it is believed will serve as a precedent for companies rendering service at rates fixed by legislation.

SAN FRANCISCO, CAL.—The Mutual Electric Light Company has filed suit against the City and County Assessor to restrain him from collecting a tax on the assessed value of the company's franchise, and, further, to have the franchise declared null and void. The principal claim advanced by the company in defence of its suit is that it holds no special privilege or franchise, inasmuch as it operates under the State law granting any person or concern the right to lay pipes or conduits under the streets of any incorporated city for the distribution of artificial light.

SEATTLE, WASH.—The Minneaplis Trust Company has brought suit against the Seattle Gas and Electric Light Company, in the Superior Court. The plaintiff claims that the company was indebted to it in the sum of $10,000, and on September 1, 1893, made a promissory note in that amount, payable one year after date. To secure the note the gas company pledged 2990 shares of its capital stock with the plaintiff. The plaintiff asks judgment for the $10,000, with interest and a foreclosure and sale of the pledged gas stock, to pay this amount.

TRANSMISSION.

FRESNO, CAL.—The 150 k. w. 1040-volt General Electric three-phase synchronous motor installed in the Sperry Flour Mill is now in regular operation by the San Joaquin Electric Company, and is rendering highly satisfactory service.

CITY OF MEXICO, MEXICO.—Francisco Espinosa & Co., and the Siemans & Halske Electric Company are along bidding for the city lighting by electricity, and should the contract be awarded to the former concern the power will be taken from the Tequisquiac tunnel debouche.

HELENA, MONT.—The Helena Electric Power & Water Company is rushing work on its power-house site at Canyon Ferry, on the Missouri river, where a dam is to be erected, giving a head of about 25 feet. An excavation of 150 feet by 75 feet is being made for the power house on a piece of land reclaimed from the river bed by a coffer-dam.

RIVERSIDE, CAL.—The transmission circuit for the Riverside municipal plant between the Redlands power house and this city is completed. It is twenty-miles in length, the poles are 30 feet long and set 120 feet apart, and the circuits are of No. 3 and No. 4 B. & S. gauge.——The Board of Trustees has made the following appointments of employees for the municipal electric plant: F. A. Worthly, general manager; Geo. A. Johnson, sub-station attendant; William Thomas, lineman, and F. C. Sweetser, Elmer Cutting and F. E. Seburn, trimmers.

OGDEN, UTAH.—The installation of the Pioneer Electric Power Company's transmission plant is progressing satisfactorily, and new contracts are being awarded almost daily. The

last important one being to Rhodes Brothers for the completion of a section of pipe line to cost $18,000. About $350,000 has been spent in preliminary work, and it is estimated that at least $1,500,000 additional will be required to complete the plant. The Weber Club, formed for the purpose of promoting the interests of Ogden, is making every effort to induce manufacturers to locate in Ogden.

PACIFIC GROVE, CAL.—The Survey Corps of the Little Sur Electric Company has completed the final survey for the pole line, its length being 21 3-5 miles of very rough country. The pole line and the large two-mile flume will be the heaviest items of expense. It is understood that the work on this power plant will soon be under way. Machinery has arrived from San Francisco to complete the water system at Carmelito, five miles from Monterey. There has been a large reservoir built, and the water will be brought from the San Jose creek. Carmelito is owned by the Carmel Coal and Land Company.

TRANSPORTATION.

OGDEN, UTAH.—Local papers are discussing the probability of an electric railway from this city to Salt Lake City.

SALEM, OR.—Thomas Holman has bought the property of the Motor Railway Company, on receiver's sale, for $4310.

PORTLAND, OR.—Use of steam on the Mount Tabor branch of the City & Suburban Railway has been discontinued, and the line is now operated electrically.

POMONA, CAL.—The Board of Trustees has repealed ordinance No. 21, rescinding a franchise to the Orange Grove Street Railway Company, because of failure to operate for six months.

SAN BERNARDINO, CAL.—The San Bernardino, Arrowhead and Waterman Motor Railway Line is now in operation, the equipment consisting of two steam motors and five cars. Oil is used as fuel.

SANTA MONICA, CAL.—The Santa Monica & Soldiers' Home Street Railway Company has been granted the right to change its line to a single or double track electric railway system, and also to extend its existing system.

SANTA BARBARA, CAL.—The track-laying for the Consolidated Electric railway system is completed, and the complete electrical equipment, including cars, is on the ground. The road will probably be in operation during the latter part of September.

SAN JOSE, CAL.—L. M. Hale has been granted an extension of time for six months from September 13th in which to commence construction on the proposed electric railway from the western boundary line of the city of San Jose to Saratoga, in Santa Clara county, and of one year from September 13, 1896, in which to complete and place in operation said railway.

SANTA ANA, CAL.—A number of local business men, headed by M. A. Menges, have paid $200 on a ninety-day option for the purchase of the Santa Ana, Orange & Tustin Railway system for $4000, and it is hoped that arrangements will be completed by which the line may be again placed in operation.——A Mr. Simms is negotiating for the purchase of the Santa Ana Gas and Electric Light Company's plant.

SAN FRANCISCO, CAL.—The Mill Valley and Mount Tamalpais Scenic Railway, extending from Mill Valley to the Summit of Mount Tamalpais, a distance of about seven miles, and affording a superb view of the Pacific ocean, the Bay of San Francisco, and all neighboring cities, was opened with fitting ceremonies on August 26th. The road is at present operated by steam, but it is intended to ultimately equip the road with electric traction.

SEATTLE, WASH.—W. J. Grambs, receiver of the Grant street electric line, filed a report with Judge Hanford for the first six months of the year 1896. The gross earnings of the road from January 1, 1896, to June 30, 1896, both inclusive, aggregated $12,861.72, and the operating expenses aggregated $11,161,01, leaving a surplus of $1700.71. Fares were collected during the six months amounting to $10,424.07, freight $59.05, revenue from power $435, lighting $1842.55, and other sources $101.05.

ILLUMINATION.

FORT JONES, CAL.—Manuel Pareira's electric light plant is now in operation.

GLOBE, ARIZ.—Chas. Barker's electric light plant will be in operation by October 1st.

SILVERTON, OR.—Coolidge & McClaine have bought the electric light plant for $3104.

QUINCY, CAL.—An electric light plant is assured, if favorable water rates can be secured.

FERNDALE, CAL.—The Ferndale Electric Light Company has placed its Westinghouse plant in operation.

DOWNIEVILLE, CAL.—A central station has been established in this town, using Westinghouse apparatus throughout.

MENDOCINO, CAL.—The Mendocino Electric Company have been granted a fifty-year franchise for an electric light plant.

JACKSON, CAL.—The Bellweather mine is now being lighted from the circuits of the Amador Railway & Light Company.

KASLO, B. C.—The City Council is receiving propositions for a light and water system, having floated $30,000 in city bonds.

COLTON, CAL.—The Board of Trustees has adopted ordinance No. 141, establishing rates for incandescent lighting service.

BENICIA, CAL.—The Solano Electric Light Company has installed a 750-light T. H. alternator, forming an addition to its plant.

ETNA, CAL.—The Etna Development Company intends to put in a water works, after which it will install an electric light plant.

COLUSA, CAL.—Certain San Francisco parties are endeavoring to induce the Board of Trustees to consider a proposition for a municipal plant.

ANGELS CAMP, CAL.—The Utica Electric Light Company has installed a 150 k. w. Westinghouse incandescent alternator, doubling its former capacity.

HERMOSILLO, MEXICO.—J. P. Wattson is erecting a municipal lighting plant here under authorization of Governor Corral, of the State of Sonora.

TOPIA, MEXICO.—H. T. Lloyd has purchased two 30 k. w. Westinghouse alternators, complete with marble switchboard and equipment for use in this State.

JUNEAU, ALASKA.—A 120 k. w. 1100-volt Westinghouse alternator, complete with marble switchboard and station appliances, has been installed by the Juneau Electric Light Company.

FRESNO, CAL.—The San Joaquin Electric Company has secured the contract for lighting the County Hospital buildings, and the contract for lighting the new Court House is practically assured.

MAYFIELD, CAL.—The Peninsula Light Company has been

granted a county franchise for the erection of electric light circuits, for a period of two years, from San Francisquito creek to Mayfield and Mountain View.

DOUGLAS ISLAND, ALASKA.—Thomas Quinn is erecting for the Alaska Treadwell Mining Company a 100 k. w. direct-current eight-pole Westinghouse generator, to be used for lighting the mine. The plant is wired up for 3000 lamps.

BISBEE, ARIZ.—E. P. Mason, of the Bisbee Water Works, has been considering the advisability of installing an electric light plant therein, to have a capacity of about 1000 incandescents and 25 arcs. The Copper Queen Consolidated Mining Company's mines may possibly be lighted therefrom. Coal costs $12.60 per short ton, delivered.

TACOMA, WASH.—The city electrician, Emil Bachelet, recommends the installation of a 3000-light alternator, to meet the demands of new business.——Ordinance No. 1120 has been established, fixing the residence rate of incandescent service from the municipal plant at 25 cents flat, the meter rate at 0.6 of a cent per lamp per hour, and the minimum rate being $1.

MISCELLANEOUS.

SAN JOSE, CAL.—An elaborate electrical display is being prepared for the county fair. Address W. W. Gillespie.

COTTAGE GROVE, OR.—The foreman of the Champion mine states that a hoisting plant will be installed, to be operated with power taken from the tramway.

SEATTLE, WASH.—Andrew Hemrich, Judge Sapp and others, of this place, are about to put in an electric plant to operate compressed air drills at their mines on Miller creek, near Skykomish.

OREGON CITY, OR.—Dr. J. C. Perry, of San Francisco, and W. C. Cheney have been experimenting on the use of the Roentgen ray for the purpose of determining the existence of free gold in quartz. The experiments were highly successful.

SACRAMENTO, CAL.—Thomas O'Brien, a lineman in the employ of the Sunset Telephone & Telegraph Company, was instantly killed on August 27th while on a pole by coming in contact with an uninsulated joint in a primary circuit carrying 1000 volts.

BODIE, CAL.—N. Westheimer, of New York, President of the Bodie, Bulwer and Mono mines, has recently been inspecting their properties, and it is stated that a result of his visit will be the erection of a transmission plant for the mines. It is believed that the power house will be located within seven miles of Bridgeport, on the Sweetwater and Bridgeport road.

NEVADA CITY, CAL.—A 250 h. p. synchronous motor, taking two-phase current at 5000 volts from the power and lighting circuit of the Nevada County Electric Power Company, has been installed in the Gold Hill mine, where it has been successfully operating all the hoists, together with a Cornish pump, a double-acting Dow pump and an air compressor for pneumatic drills for several weeks. A recent fire caused the loss of about $1500 to the Electric Power Company in poles and wires burned.

LOS ANGELES, CAL.—The newspapers are warning the public against a "glib young man," who has been exhibiting the "Wonderful X-Rayograph" to hundreds of people. The outfit has been experted, however, and has been found to consist of angle mirrors, by means of which vision is carried around rather than through blocks of wood.——The Los Angeles Electrician Union has elected the following officers: President, F. S. Roney; Vice-President, James Hammersley; Secretary and Treasurer, John Lloyd; Executive Board, F. S. Roney, S. L. Colburn, Charles Evans, Thomas Storie, A. H. Miller, F. A. Beem.

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Abbreviations: Illustrated (*); Editorial, (Ed.); Educational, (Educ.); Electro-Economics, (Elec-Econ.); Electro-Insurance, (Elec-Ins.); Electro-Therapeuty, (Elec-Ther.); Financial, (Fin.); Hydraulics, (Hyd.); Illumination, (Ill.); Literature, (Lit.); Metallurgy, (Met.); Mining, (Mi.); Passing Comment, (P. C.); Physics, (Phys.); Pneumatics, (Pneu.); Telegraphy, (Teleg.); Telephony, (Telep.); The Trade, (T.); Transmission, (Transm.); Transportation, (Transp.)

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